

CLAIMS

What is claimed is:

- 1 1. A method, comprising determining an available bandwidth of a communication
2 between two nodes of a computer network communicatively coupled by the communication
3 path using probe packages that are transmitted between a sender one of the nodes and a
4 receiver one of the nodes via the communication path at varying transmission rates, each
5 successive transmission rate being selected according to: (i) an achieved throughput for a
6 transmission of a preceding one of the probe packages, and (ii) a deviation between the
7 achieved throughput for the transmission of the preceding one of the probe packages and a
8 corresponding transmission rate of the preceding one of the probe packages.
- 1 2. The method of claim 1, wherein selection of a first one of the transmission rates for the
2 probe packages is performed with knowledge of a bottleneck bandwidth for the
3 communication path.
- 1 3. The method of claim 1, wherein selection of a first one of the transmission rates for the
2 probe packages is performed without knowledge of a bottleneck bandwidth for the
3 communication path.
- 1 4. The method of claim 1, wherein the probe packages comprise a number of packets.
- 1 5. The method of claim 4, wherein the sender one of the nodes advises the receiver one of
2 the nodes of the number of packets comprising each of the probe packages.

1 6. The method of claim 5, wherein the sender one of the nodes advises the receiver one of
2 the nodes of the number of packets comprising each of the probe packages via a control
3 channel between the two nodes.

1 7. The method of claim 6, wherein communication between the two nodes over the
2 control channel takes place using a reliable transmission protocol.

1 8. The method of claim 7, wherein the reliable transmission protocol comprises a
2 transmission control protocol (TCP).

1 9. The method of claim 7, wherein prior to transmission of a first one of the probe
2 packages, the receiver one of the nodes receiver from the sender one of the nodes
3 bottleneck bandwidth information of the communication path.

1 10. The method of claim 9, wherein the receiver one of the nodes advises the sender one of
2 the nodes of the bottleneck bandwidth using the control channel.

1 11. The method of claim 1, wherein the receiver one of the nodes instructs the sender one
2 of the nodes regarding a first transmission rate to use for a first one of the probe packages.

1 12. The method of claim 11, wherein instructions from the receiver one of the nodes to the
2 sender one of the nodes are communicated using a control channel.

1 13. The method of claim 12, wherein communications using the control channel make use
2 of a reliable communication protocol.

1 14. The method of claim 13, wherein the reliable communication protocol comprises a
2 transmission control protocol (TCP).

1 15. The method of claim 1, wherein each of the probe packages comprises a number of
2 user datagram packets (UDPs).

1 16. A method, comprising transmitting probe packages from a first node of a computer
2 network to a second node of the computer network at varying transmission rates and
3 estimating an available bandwidth of a communication path between the first and second
4 nodes as a transmission rate at which the probe packets start creating congestion within the
5 communication path.

1 17. The method of claim 16 wherein the varying transmission rates are selected according
2 to: (i) an achieved bandwidth for a transmission of a preceding one of the probe packages,
3 and (ii) a deviation between the achieved bandwidth for the transmission of the preceding
4 one of the probe packages and a corresponding transmission rate of the preceding one of
5 the probe packages.

1 18. The method of claim 17 wherein the varying transmission rates are increased for
2 successive transmissions of probe packages until a probe package transmission rate (t_s)
3 exceeds a corresponding achieved probe package throughput (t_e) over the communication
4 path.

1 19. The method of claim 18 wherein once t_s exceeds t_e , the varying transmission rates are
2 increased over a last transmission rate (t_r) for which the probe package transmission rate

3 did not exceed a corresponding achieved probe package throughput over the
4 communication path by a fraction of a transmission rate range defined by a difference
5 between t_s and t_r until t_s no longer exceeds t_r .

1 20. The method of claim 19 wherein once t_s no longer exceeds t_r , the varying transmission
2 rates are again increased up to an estimated available bandwidth of the communication path
3 by using t_s as a new value for t_r and adding the fraction of the transmission rate range to this
4 new value of t_r .

1 21. The method of claim 20 wherein the estimated available bandwidth of the
2 communication path is determined as being one of (i) an acceptable fraction of a bottleneck
3 bandwidth of the communication path, or (ii) a value of the achieved probe packet
4 throughput that is within an acceptable percentage of a corresponding probe package
5 transmission rate.